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# EFFECT OF ENZYME SUPPLEMENTATION ON THE NUTRITIVE VALUE OF MALTED SORGHUM SPROUT IN THE RAT

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Target Audience: Animal nutritionists, breweries, food industrious, livestock farmers.

## ABSTRACT

The composition of malted sorghum sprout (MSP) and its nutritive value when supplemented with an exogenous enzyme was investigated using weanling albino rats. A nitrogen free basal diet was formulated along with a soya bean meal (SBM) reference diet (10% CP) and two test diets each containing 10% CP supplied by MSP. One of the two diets was further supplemented with Roxaxyme which is an exogenous enzyme that contains cellulase, glucanase, hemicellulase and protease. The 40 weanling albino rats used for the experiment were divided into 4 groups of 10 rats and each group was allotted to the different diets. The rats were individually housed in cages with facilities for separate urine and faecal collection. Performance characteristics and blood components of the rats were used as criteria of response.

MSP contains 199.7, 28.3, 83.0, 74.9 and 52.9 g $kg^{-1}$ of CP, EE, CF, ash and NFE respectively. Potassium (16.67 g $kg^{-1}$) and Fe (589.93 mg $kg^{-1}$) were the most abundant major and trace minerals respectively. The correspondingly least abundant minerals are Ca (0.59g $kg^{-1}$) and Cu (2.21 g $kg^{-1}$).

Supplementation of MSP diet with exogenous enzyme significantly increased ($P<0.05$) the growth rate, feed intake, protein efficiency ratio, net protein retention and apparent protein digestibilities of the rats. But all these values were lower ($P<0.05$) than those obtained for the reference (SBM) diet.

Serum, $Na^+$, $K^+$ $Cl^-$, $HCO_3^-$, were increased ($P<0.05$) in rats that received MSP diets. While the levels of serum total protein, albumin, glutamate oxaloacetate transaminase and glutamate pyruvate transaminase did not vary significantly with dietary treatments.

Addition of enzyme increased ($p<0.05$) the level of serum cholesterol in rats. It was concluded that the nutritive value of MSP is quite low. However, supplementing MSP based diets with suitable exogenous enzymes could enhance its feeding value.

Keywords: Malted sorghum sprout, Enzyme supplementation, nutritive value, Rat.

## DESCRIPTION OF PROBLEM

Malted sorghum sprout, a waste product of sorghum malting in Nigerian Brewing and Food industries is one of the largest underutilized feed resources whose nutritional potential is now receiving some attention.

Malting sorghum essentially involves soaking or steeping, followed by fermentation of seed. Malt is extracted from the germinated sorghum seeds and the residue which consists of dried shoot and roots are referred to as malted sorghum sprout (MSP). Many food and brewing industries in Nigeria have commenced full scale sorghum malting, hence, there is concomitant production of MSP on a commercial scale (1).

The potentials of MSP as a feed resource is not in question. Preliminary analyses of the product showed that it contained 350.0 and 170.0 g $kg^{-1}$ and crude fibre respectively (1). But as expected, the crude fibre fraction as well as the tannin content of MSP might constitute a hitch for the full utilization of this novel feed resource by monogastric animals especially.

However, recent advances in animal nutrition have indicated that exogenous enzyme supplementation can render fibrous polysaccharides utilizable, by broiler chicks (2). The study was undertaken to determine the effect of enzyme supplementation on the nutritive value of MSP to rats.

## MATERIALS AND METHODS

A nitrogen free basal diet was formulated to contain maize starch (647.5g), glucose monohydrate (50.0g), sucrose (100g), non nutirtive cellulose (50.0g), vegetable oil (100g), premix (20g), oyster shell (10g), bone meal (20g) and salt (2.5g) per kg of diet. A soybean meal reference diet was also formulated to supply 10% CP at the expense of maize starch. Two test diets each containing 10% CP supplied by MSP were made by substituting MSP for starch. One of the test diets was supplemented with a commercial enzyme: Roxaxyme, which contains a mixture of cellulases, B-glucanases, hemicellulases and proteases. A total of 40 weanling albino rats divided into 4 groups of 10 rats each were used. Each of the groups received either the basal, soyabean reference or one of the 2 test diets. The rats were individually housed in cages with facilities for separate urine and faecal collection.

The rats were weighed at the beginning of the experiment and at weekly intervals till the end of the experiment, which lasted for 21 days. Feed intake was recorded daily. Collection of faeces was done daily for the last 7 days of the trial and analysed for dry matter and nitrogen (3). On the last day of experiment, all the rats were sacrificed, dissected and blood was collected directly from the heart using syringe and needle into

heparinised tube for subsequent determination of haematological parameters. These include serum total protein, albumin, globulin, cholesterol, triglyceride, $Na^+$, K, $Cl^-$ $HCO_3^-$, glutamate oxaloacetate transaminase (GOT) glutamate pyruvate transaminase (GPT).The spectrophotometric procedures described in Sigma Diagnostic (Technical bulletin) Nos 500, 505, 525 and 540 were followed (4, 5, 6, 7).

A completely randomized design was used. Analysis of variance technique was employed to analyse the data generated while significance between treatment mean values were tested using Duncans multiple range test (8).

## RESULTS AND DISCUSSION

The crude protein value of MSP (199.7gkg$^{-1}$) obtained in this study (Table 1) is not too different from the values reported in literature, (226.0gkg$^{-1}$) (9) and (221.0gkg$^{-1}$) (10). A value of 350gkg$^{-1}$ was obtained by Ikediobi (1). Difference in the results of analysed MSP from different authors might be due to period of fermentation, variety of sorghum used or probably the method of chemical analysis employed.

Table 1: Proximate composition, mineral profile and the HCN content of malted sorghum sprout.

| | |
|---|---|
| Proximate gkg$^{-1}$ | |
| Dry matter | 915.2 |
| Crude protein | 199.7 |
| Ether extract | 28.3 |
| Crude fibre | 83.0 |
| Ash | 74.9 |
| NFE | 529.3 |
| Mineral Profile | |
| Ca (gkg$^{-1}$) | 0.59 |
| P (gkg$^{-1}$) | 3.79 |
| K (gkg$^{-1}$) | 16.67 |
| Mg (gkg$^{-1}$) | 2.02 |
| Na (mgkg$^{-1}$) | 49.17 |
| Mn (mgkg$^{-1}$) | 51.06 |
| Fe (mgkg$^{-1}$) | 589.93 |
| Cu (mgkg$^{-1}$) | 2.21 |
| Zn (mgkg$^{-1}$) | 104.69 |
| HCN (mgkg$^{-1}$) | 51.13 |

Slight or major differences in the procedure of malting could also result in products that have varying composition. MSP has low ether extract value (28.3gkg$^{-1}$) while its content of nitrogen free extract and ash are normal for a feed ingredient in its category. The crude fibre level obtained in this study (83.0gkg$^{-1}$) was quite low. Out of the major minerals analysed,

potassium (K) was the most abundant while calcium was the least. Among the trace minerals, iron (Fe) and zinc (Zn) were the most abundant, while copper (Cu) was the least. Generally, MSP is rich in its content of major and trace minerals and this will have implications when it is incorporated in animal diets. The presence of HCN, 51.13mgkg$^{-1}$ in MSP is note worthy.

Supplementation of the MSP diet with Roxaxyme significantly increased ($P < 0.05$) the growth rate and final live weights of the experimental rats. However, rats that received the reference diet had higher growth rates and final live weights than those fed MSP with enzyme (Table 2). Enzyme

**Table 2:** Performance and Nutrient utilization of weanling rats fed enzyme supplemented malted sorghum sprout based diets.

| Parameters | Reference diet (Soybean meal) | Msp | Msp + Enzyme |
|---|---|---|---|
| Initial Weight (g) | 37.93 ±± 0.80 | 36.75 ±± 0.14 | 36.98 ±± 0.27 |
| Final weight (g) | 85.70$^{a}$ ±± 6.42 | 37.50$^{c}$ ±± 5.26 | 40.98$^{b}$ ±± 4.61 |
| Weight gain (g) | 47.77$^{a}$ ±± 0.54 | 0.75$^{c}$ ±± 0.08 | 4.00$^{b}$ ±± 1.85 |
| Feed intake (g) | 165.51$^{a}$ ±± 8.16 | 90.62$^{c}$ ±± 6.57 | 98.48$^{b}$ ±± 4.24 |
| Protein Efficiency ratio | 1.65$^{a}$ ±± 0.08 | 0.095$^{c}$ ±± 0.19 | 0.32$^{b}$ ±± 0.15 |
| Net Protein retention | 1.58$^{a}$ ±± 0.06 | -0.49$^{c}$ ±± 0.09 | 0.20$^{b}$ ±± 0.13 |
| Apparent Protein Digestibility | 78.33$^{a}$ ±± 0.41 | 55.98$^{c}$ ±± 3.18 | 62.59$^{b}$ ±± 2.16 |

abc Means in the same row not followed by the same superscript are significantly ($P<0.05$) different

supplementation of MSP definitely led to break down of cell wall components i.e cellulose and hemicellulose to their simpler derivatives like cellobiose or even glucose. This would have resulted in more complete digestion of complex carbohydrate and protein in the small intestine of the animals (11). The enzyme used contains a combination of cellulases, B-glucanases, hemicellulases and proteases. This is evident from the higher apparent protein digestibility obtained for rats fed MSP diet + enzyme over those fed MSP diet alone. At the end of the feeding trial,however, rats on MSP+ enzyme recorded a lower ($P < 0.05$) live weight compared to those on the reference diet . This showed that MSP inherently does not contain good quality protein that can support effective growth. It was reported that sorghum grain and distillers dried grain are deficient in lysine, threonine and methionine (12). The implication is that MSP cannot be used as a main protein source in monogastric animal diets. In fact, rats fed the reference diet were growing at a rate that was 83.34% higher than those on the MSP + enzyme diet.

Table 3: Mean values of some blood components of weanling rats fed enzyme supplemented malted sorghum sprout based diets.

| Parameters | Reference diet Soybean Meal | Msp | Msp +Enzyme |
|---|---|---|---|
| Na+ (mmol/litre) | 128.00$^{c}$ ±± 0.29 | 142.33$^{a}$ ±± 0.8 | 138.33$^{b}$ ±± 3.18 |
| K+ (mmo/litre) | 4.87$^{b}$ ±± 0.41 | 5.10$^{b}$ ±± 0.26 | 6.20$^{a}$ ±± 0.58 |
| Cl- (mmo/litre) | 97.33$^{c}$ ±± 0.88 | 104.60$^{a}$ ±± 0.33 | 102.00$^{b}$ ±± 1.53 |
| HCO3- (mmo/litre) | 20.00$^{b}$ ±± 0.00 | 22.33$^{a}$ ±± 1.45 | 20.67 ±± 0.67 |
| Serum Total Protein (g/dl) | 5.57 ±± 0.12 | 5.83 ±± 0.15 | 5.77 ±± 0.15 |
| Serum Albumin (g/dl) | 2.43 ±± 0.03 | 2.73 ±± 0.15 | 2.63 ±± 0.09 |
| Serum globulin (g/dl) | 3.30 ±± 0.19 | 3.02 ±± 0.03 | 3.30 ±± 0.11 |
| Serum cholesterol (mg/dl) | 82.00$^{a}$ ±± 3.99 | 68.33$^{b}$ ±± 1.77 | 83.3$^{a}$ ±± 5.93 |
| Triglyceride (mg/dl) | 59.67$^{a}$ ±± 0.33 | 52.33$^{b}$ ±± 6.50 | 54.67$^{b}$ ±± 4.49 |
| GOT IU/L | 31.67 ±± 1.46 | 31.0 ±± 6.09 | 35.10 ±± 5.69 |
| GPT IU/L | 17.33 ±± 1.76 | 18.67 ±± 4.10 | 15.33 ±± 3.53 |

abc Means in the same row not followed by the same superscript are significantly ($P < 0.05$) different. GPT Glutamate Pyruvate transaminase, GOT, Glutamate oxaloacetate transaminase

Addition of enzyme increased ($P < 0.05$) the feed intake of the rats fed MSP diet. But the rats on reference soybean diet still had the highest consumption rate. This may be so probably because of the presence of tannin (which is known to impact a bitter taste on the product.) and therefore reduce acceptability when fed at high levels. The values of protein efficiency ratio, net protein retention and the apparent protein digestibility further confirmed that addition of enzyme to the MSP diet enhanced the ability of the rats to utilize MSP. The MSP diets produced rats that consistently had higher levels of $Na^{+}$ $K^{+}$ $Cl^{-}$ and $HCO_3^{-}$ in their serum than those on reference diet (Table 3). This was probably due to a direct effect of the appreciably high levels of these minerals in the blood. No difference was observed among the different dietary treatments for serum total protein and its albumin and globulin fractions. It has been earlier confirmed that serum albumin is not a sensitive index of measurement of protein adequacy (13).

Marginally elevated levels of GPT in serum of rats fed MSP diet without enzyme, may be indicative of increased catabolism of amino acids due to

dietary cyanide. Studies (14) showed that increased activities of serum GOT and GPT activities are indices of increased catabolism of amino acids. The slightly reduced levels of GPT in serum of rats fed the MSP plus enzyme diet may as well indicate that the enzyme had a palliative effect on the adverse effect of the cyanide. It is noteworthy that the addition of enzyme increased ($P < 0.05$) the level of serum cholesterol in rats fed the enzyme supplemented MSP diet. The same was noticed in the level of circulating triglyceride although the increase was not significant in this case. No ready explanation could be advanced for this observation except that activities of the enzyme enhanced the energy status of the animals.

## CONCLUSION AND APPLICATION

1. The Nutritive value of MSP is quite low and cannot be used as a main protein source in monogastric feeding.
2. Supplementing MSP diets with Roxazyme enhanced its usefulness to rats.

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